

# A generic revision of the insect order Phasmatodea: The genera of the areolate stick insect family Phylliidae (Walking Leaves)

(Insecta, Orthoptera)

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The genera of the family Phylliidae (Walking Leaves) (Phasmatodea: Areolatae) are revised and the relationships between them discussed. *Nanophyllum* Redtenbacher, 1906 differs strikingly from the other genera and is transferred in the *Nanophylliini*, trib. nov. A key to genera and species is provided.

*Nanophyllum adisi*, spec. nov. from New Guinea is described for the first time. The paper includes a key to the species of *Nanophyllum*.

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## Introduction

The species of the areolate family Phylliidae are well known as “Walking Leaves” or “Leaf Insects”. Several species have been reared by enthusiasts, and many zoos exhibit specimens. So it is astonishing that to date only a few larger publications on this group are available, a revision of the genus *Phyllum* Illiger, 1798 by Klante (1976) and a well illustrated book on the whole family by Größer (2001). The first reviews of this family have been published by Griffini (1898a,b). The systematic rank of this family is obvious, since all members share several synapomorphies, but the relations between the genera have not been discussed previously.

This paper is part of an ongoing work on the systematics of the Phasmatodea (Zompro 2001a).

## Material and methods

Material in various public and private collections was examined. Examinations were executed with a Zeiss-Citival-2 stereoscope, drawings were made using a drawing-tube, a few photos were taken with a Pentax-Super-A camera attached to this stereoscope. Measurements were taken using an MBC-9 stereoscope and a special ocular scale, both Russian make.

Museum codes are as follows: BMNH: The Natural History Museum, London, England; DEIC: Deutsches Entomologisches Institut, Eberswalde, Germany; DEICDG: Collection of Detlef Größer, Berlin, Germany, affiliated with DEIC; MCSN: Museo Civico di Storia Naturale “Giacomo Doria”, Genua, Italy; MNHU: Museum für Naturkunde der Humboldt-Universität, Berlin, Germany; SMTD: Staatliches Museum für Tierkunde, Dresden, Germany; ZMH: Zoologisches Museum der Universität Hamburg, Germany; ZMUK: Zoologisches Museum der Christian-Albrechts-Universität, Kiel, Germany; ZSMC: Zoologische Staatssammlung, München, Germany; ZMUKOZ: Collection of Oliver Zompro, Kiel, Germany, affiliated with ZMUK.

Abbreviations used are: HT: holotype, PT: paratype.

## Results and discussion

Phylliidae – Walking Leaves or Leaf Insects

Phylliidae Brunner v. Wattenwyl, 1893: 101; Griffini 1898a: 1; 1898b: 8; Bradley & Galil 1977: 204.

Phyllinae, Rehn 1904: 105.

Phyllini, Redtenbacher 1906: 172.

Phylliinae, Kirby 1904: 420; Günther 1953: 549; Klante 1976: 49.

Phylliidae, Bragg 2001: 189; Zompro 2001e: 51; Größer 2001: 3.

Genera and subgenera included: *Chitoniscus* Stål, 1875; *Microphyllium* Zompro, 2001; *Nanophyllum* Redtenbacher, 1906; *Phyllium* (*Phyllium*) Illiger, 1798 = *Pteropus* Thunberg, 1815; *Phyllium* (*Pulchriphyllum*) Griffini, 1898.

**Diagnosis.** Areolate Phasmatodea with striking leafmimesis. Body extremely flattened dorso-ventrally. Pronotum only slightly shorter than mesonotum. Tegmina in females often fully developed, always covering alae. Legs short. Femora and tibiae often strikingly lamellate. Profemora straight and not compressed basally. All tibiae with area apicalis, the latter bearing a spine mediodistally. Abdominal tergites and sternites foliaceously broadened. Striking sexual dimorphism: Antennae in females consisting of nine segments, shorter than head, with stridulation organ on third antennomere.

Eggs with cork-like capsule, coloured in different shades of brown, micropylar plate elongated, internal micropylar plate closed, fringed with an almost regular series of strips. Capitulum absent. The eggs are dropped.

The family includes only one subfamily, Phylliinae, with the tribes Phylliini and Nanophylliini, trib. nov.

**Distribution.** The four genera included are distributed in tropical Asia and Northern Australasia. There is evidence that walking leaves occur also in Eastern Africa, Madagascar and neighbouring islands. From the author's point of view these records are based on introduced specimens, as the specimens examined belong to Asian species. In Madagascar, Mauritius and Reunion the introduced species have established populations.

**Stridulation.** Several groups of Phasmatodea are able to produce sounds, mainly with the wings, but the Phylliidae are the only phasmids which have the ability of stridulation, which was first recorded by Henry (1922) and later discussed by Größer (1989). The stridulation is executed with a specialized or-

gan on the third antennomere, consisting of a ridge-like plectron and a row of teeth. These structures are moved against each other. In the females this organ is present in all stages, while it is reduced in the adult males. The number of teeth is specific for each species. Größer (2001) figures these organs for eleven species. Adult females stridulate stronger when adult males are around (Größer 2001).

**Defence.** The use of the prothoracal glands in *Phyllium* spp. has been described for *Phyllium celebicum* by Größer (1990).

**Discussion.** In all probability the Phylliidae are monophyletic, since all species and genera share numerous synapomorphies. The structure of the abdomen is unique within the Phasmatodea: If abdominal segments appear foliaceous, usually only the tergites are broadened, while in Phylliidae both, tergites and sternites, are expanded. The abdominal segments are strongly transverse. Another apomorphy of this group is the striking sexual dimorphism. The antennae differ greatly. Females possess nine antennomeres. They have the ability to stridulate with an organ on the third antennomere. The fourth to ninth segments are broad and short. Adult males bear considerably more antennomeres, up to 26; the antennomeres from the third one onwards are distinctly longer than wide. Male nymphs also have the ability to stridulate, featuring the same organs as the females; these organs are reduced in the final moult.

The long tegmina of the females are probably not plesiomorphic, as, in all probability, they have been re-developed subsequently, to increase the perfect camouflage of these insects. This is indicated by the strongly reduced venation, which resembles that of a leaf. Veins of male and female *Phyllium* tegmina are very different to other phasmids, in which most veins are conserved, and therefore almost certainly synapomorphic.

The egg capsules feature two synapomorphies. The cork-like wall of the capsule is unique within Phasmatodea, as are the striking, very even fringes surrounding the internal micropylar plate.

To date, the family has not been subdivided in subfamilies or tribes. A re-examination of the genera provided information which makes a subdivision necessary.

The genus *Nanophyllum* differs from all other genera by its iridescent alae and the brownish anal region. Further the head bears two posteromedian tubercles instead of one in the other genera. *Chitoniscus*, *Microphyllium* and *Phyllium* are obviously much closer related to each other. A synapomorphy of these genera are the transparent alae and the head bears only one spine or tubercle posteromedi-

ally. Therefore *Nanophylliini*, trib. nov. is established, to include *Nanophyllium* Redtenbacher, 1906. The most primitive member of the Phylliini is *Microphyllium*. The abdomen of the males is only weakly dilated. The anterior half of the prosternum is swollen, and the mesonotum is strongly transverse, both features are plesiomorphies also found in the *Nanophylliini*. An autapomorphy of *Chitoniscus* and *Phyllium* which is absent in *Microphyllium* is the prosternal spine, which is reduced in most, but still present in some species of *Phyllium* (e.g. *P. caudatum*).

*Phyllium*-species are characterized by the quadrate mesonotum, which is not distinctly transverse as in the previous genera.

No fossils are known of Phylliidae. The short and broad head is similar to Aschiphasmataidae, Prisopodidae and the fossil Archipseudophasmataidae from Baltic amber. Possibly the latter family is the ancestor of these groups, also it features additional characters exhibited by Pseudophasmataidae and Heteronemiidae (Zompro 2001d).

*Psidium guajava* Linnaeus (Myrtaceae) and *Theobroma cacao* Linnaeus (Sterculiaceae) are often cited as natural foodplants of Phylliidae. This is not possible, since both plants have been introduced from South America only some centuries ago.

#### Key to genera and subgenera of Phylliidae

1. Head with two tubercles posteromedially, wings iridescent, anal region of alae brown .....  
..... *Nanophylliini*, trib. nov.  
..... (*Nanophyllium* Redtenbacher)
- Head with only one tubercle or spine posteromedially, anal region of alae transparent .....  
..... 2. Phylliini
2. Mesonotum in front of tegmina distinctly transverse ..... 3.
- Mesonotum in front of tegmina almost quadrate ..... 4.
3. Anterior half of prosternum without spine .....  
..... *Microphyllium* Zompro
- Anterior half of prosternum with distinct spine .....  
..... *Chitoniscus* Stål
4. Protibiae with exterior lobes only .....  
..... *P. (Phyllium)* Illiger
- Protibiae with interior and exterior lobes .....  
..... *P. (Pulchriphyllium)* Griffini

#### *Nanophylliini*, trib. nov.

**Diagnosis.** Small Phylliidae. Visible part of mesothorax in front of tegmina quadrate. Prosternum without distinct spine medially. Alae slightly iridescent, anal region brownish-transparent, sometimes white interiorly\*. In males vomer strikingly elongated, parallel sided, twice as long as wide.

**Distribution.** New Guinea, Northern Australia.

Only one genus included: *Nanophyllium* Redtenbacher, 1906.

#### *Nanophyllium* Redtenbacher, 1906

*Nanophyllium* Redtenbacher, 1906: 180; Klante 1976: 50; Größer, 2001: 49.

**Type-species.** *Nanophyllium pygmaeum* Redtenbacher, 1906, by original designation.

**Distribution.** New Guinea, Australia.

**Diagnosis.** As for the tribe.

**Species included.** *Nanophyllium adisi*, spec. nov.; *Nanophyllium pygmaeum* Redtenbacher, 1906: 180, pl. 6: 16.

**Material examined.** See below.

**Comments.** Rentz (1988) recorded the discovery of this genus in Australia. These specimens were not available to the authors and could only be examined from a picture, but they appear closer related to *N. pygmaeum* than to *N. adisi*.

#### Key to males of *Nanophyllium* Redtenbacher, 1906

1. In profemora interior and exterior lobe of same size ..... *N. pygmaeum* Redtenbacher, 1906
- In profemora exterior lobe much larger than interior one ..... *N. adisi*, spec. nov.

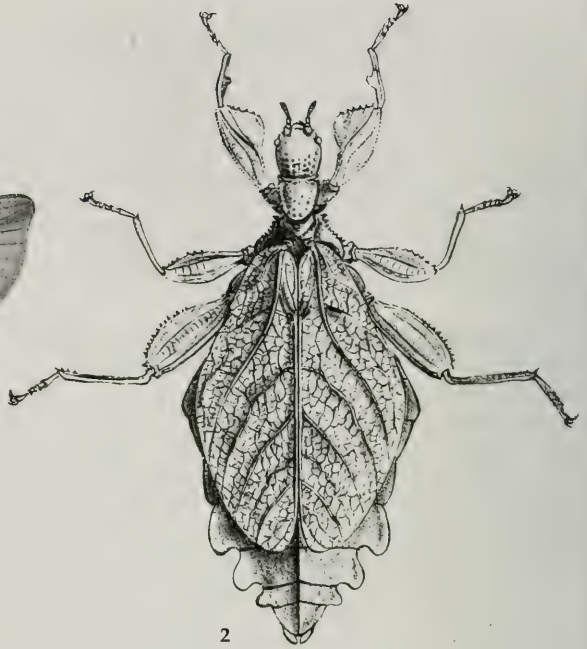
#### *Nanophyllium pygmaeum* Redtenbacher, 1906

**Material examined.** HT, ♂, N. Guinea Katau 1876 D'Albertis; Typus; *pygmaeum* Redt.; 114 [MCSN].

\* Brock and Hasenpusch (in progress) are describing a new *Nanophyllium* species from Irian Jaya. The male has brown wings with a white inner patch. The likely female of this species closely resembles *Phyllium* (Brock, pers. com.).



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Fig. 1. *Chitoniscus lobiventris* (Blanchard, 1853) ♂, after Blanchard, 1853, pl. 1: 9.

Fig. 2. *Chitoniscus lobiventris* (Blanchard, 1853) ♀, after Westwood, 1859, pl. 39: 5.

**Diagnosis.** Characterized by the length of the antennae, which are shorter than the forelegs, and the small head. Further distinguished from *N. adisi*, spec. nov. by the narrower venation of the tegmina. In profemora interior and exterior lobe of same size. Lengths (mm), HT ♂, Body: 28.7; head: length: 2.3; width: 2.3; antennae: 7.8+; antennomeres l/r: 1+/12+; pronotum: 1.9; mesonotum: 1.5; metanotum: 2.9; median segment: 1.3; tegmina: 4.9; alae: 23.0; profemora: 6.0; protibiae: 4.1; protarsi: 3.8; mesofemora: 5.3; mesotibiae: 4.6; mesotarsi: 3.5; metafemora: 6.1; metatibiae: 6.2; metatarsi: 4.1.

*Nanophyllium adisi*, spec. nov.

*Nanophyllium pygmaeum*: Günther, 1936: 325 (non Redtenbacher, 1906).

**Types.** Holotype: ♂, N. N. Guinea Exp. 1926. W. Docters v. Leeuwen. Hoofbivak 250 m. Datum IX. [SMTD].

**Diagnosis.** Very characteristic by its large head and the antennae, which are much longer than the forelegs. Further distinguished from *N. pygmaeum* by the form of the lobes on the femora. Venation of tegmina raised and light in colour.

**Description**

Head light brown with darker area medially, slightly transverse, flattened dorsoventrally. Three ocelli present, an anterior small one and two larger posterior ones. Eyes projecting considerably more than hemispherically. Head bearing two small black tubercles medioposteriorly. Antennae consisting of 22 antennomeres, projecting beyond abdominal segment II. Scapus transverse, almost triangular in cross-section with pointed lateral carinae. Pedicellus two thirds as long as scapus, disc-shaped. Segments three to 17 bearing long, black bristles. Third antennomere longer than previous two segments combined, triangular in shape, posteroventral edge projecting. Third to eighth segments of similar shape, following antennomeres elongated, slightly club-shaped, terminal five segments flattened, 20<sup>th</sup> transverse, 21<sup>st</sup> quadrate, terminal segment short, triangular.

Pronotum shorter than head, posterior half semicircular, with deep cross-shaped impression medially. Anterior margin broad, concave, anterolateral edges projecting and pointed. Prosternum swollen. Mesonotum shorter than pronotum, transverse, trapezoid, lateral margin bearing five to seven definite spines. Metanotum more than twice as long as mesonotum.

Profemora straight, with large triangular lobes interior and exteriorly. Interior lobes with three

spines anteriorly. Protibiae with a small, triangular exterior lobe and a large, rounded interior lobe. Tarsomeres triangular in cross-section. Proboscis elongated, longer than next three segments combined. Second to third tarsomere decreasing in length, fourth disc-shaped. Fifth segment as long as second and third combined. Claws curved, about as long as second segment. Arolium large, trapezoid. Meso- and metafemora with a rounded exterior lobe and a serrated one interiorly. Meso- and metatibiae with small, triangular lobe exteriorly. Meso- and metatarsi as protarsi.

Tegmina projecting slightly beyond metanotum, veins slightly raised and very light brown. Radial vein, forming a raised ridge medially. Alae reaching tip of abdomen, iridescent, anal region translucent brown, with brown veins.

Abdominal segments I to VI increasingly broader, VII to X decreasing in width, X roundly triangular, with median carina dorsally. Cerci elongated foliaceous, vomer elongated triangular.

Lengths (mm), HT ♂, Body: 30.6; head: length: 2.6; width: 2.5; antennae: 13.2; antennomeres 1/r: 22/16+; pronotum: 1.8; mesonotum: 1.6; metanotum: 3.5; median segment: 2.0; tegmina: 4.2; alae: 23.5; profemora: 5.2; protibiae: 3.5; protarsi: 3.4; mesofemora: 4.6; mesotibiae: 3.9; mesotarsi: 3.4; metafemora: 5.6; metatibiae: 5.6; metatarsi: 3.6.

Female and egg unknown.

**Name.** The authors wish to dedicate this striking species to Prof. Dr. Joachim Adis (Max-Planck-Institut, Plön, Germany), to acknowledge his support to O. Zompro during recent years.

### Phylliini

**Diagnosis.** Small to large Phylliidae. Alae not iridescent, anal region transparent. In males vomer triangular, not strikingly elongated.

**Distribution.** Tropical Asia and the Northern Australis. Introduced (?) in Eastern Africa, Madagascar and neighbouring islands.

**Genera and subgenera included.** *Chitoniscus* Stål, 1875; *Microphyllium* Zompro, 2001; *Phyllium* (*Phyllium*) Illiger, 1798 = *Pteropus* Thunberg, 1815; *Phyllium* (*Pulchriphyllium*) Griffini, 1898.

### *Chitoniscus* Stål, 1875

*Chitoniscus* Stål, 1875: 62; Kirby 1904: 420; Redtenbacher 1906: 178; Klante 1976: 50; Größer 2001: 42.

**Type-species.** *Phyllium lobiventre* Blanchard, 1853: 359, pl. 1: 9, by original designation.



Fig. 3. *Microphyllium spinithorax* Zompro, 2001, ♂, HT.

**Distribution.** New Caledonia, Fiji.

**Diagnosis.** Medium sized Phylliini, characterized by the transverse visible part in front of the tegmina and a distinct prosternal spine. Anal region of alae transparent. In males vomer triangular.

**Species included.** *Phyllium brachysoma* Sharp, 1898: 92, pl. 8: 13; *Chitoniscus erosus* Redtenbacher, 1906: 179; *Phyllium feedjeeanum* Westwood, 1864: 17 = *Phyllium Novae-britanniae* Wood-Mason, 1877: 75, synonymized by Redtenbacher, 1906: 180; *Chitoniscus lobipes* Redtenbacher, 1906: 178, pl. 6: 15; *Phyllium lobiventre* Blanchard, 1853: 359, pl. 1: 9.

**Material examined.** *C. brachysoma* (Sharp, 1898): 1♂, 1♀, Pelew MG 2684 [ZMH].

*C. fecjeeanus* (Westwood, 1859): 1♀, Ovalau MG 2684 [ZMH]; 2♀, 1♀, n5, Ovalau H. Waschmann 1911 [ZMH]; 1♀, Fiji-Inseln, Vana-Leu, Salave. Eing. No. 1. 1926. [ZMH].

*C. lobipes* Redtenbacher, 1906: 1♀, Fiji-Inseln Dr. Friedländer S. [MNHU].



Fig. 4. *Nanophyllium pygmaeum* Redtenbacher, 1906, ♂, HT.

*C. lobiventris* (Blanchard, 1853): 3♀, 1♀, n5, Fidschi Insel Ovalau H. Waschmann ded. [ZMH]; 1♀, Viti MG 218. (These specimens have been examined and determined by Redtenbacher).

**Comments.** The ventral lobes on the protibiae differ considerably within a species. The series of three females of *C. lobiventris* from Ovalau in ZMH contains one female with a very prominent lobe, an intermediate one and a specimen where the lobe is almost invisible. Therefore, it is possible that all species described from Fiji with lobes on the abdominal segments belong to one species only. In the series of specimens in the ZMH no variation in the form of the abdomen is visible, as it is almost typical for species of *Phyllium*. But two species, *C. lobiventris* and *C. feejeanus* were collected on Ovalau; the ventral lobes on the protibiae of *C. feejeanus* are as big as the smallest in the series of *C. lobiventris*. Egg material would be desirable to clear the validity of the species.



Fig. 5. *Nanophyllium adisi*, spec. nov., ♂, HT.

#### Preliminary key to males of *Chitoniscus* Stål, 1875

1. Ocelli absent ..... *C. feejeanus* (Westwood)
- Ocelli present .....
2. Protibiae at least with distinct interior lobe .....
- ..... *C. lobiventris* (Blanchard)
- Protibiae at best evenly dilated interiorly .....
- ..... *C. brachysoma* (Sharp)

#### Preliminary key to females of *Chitoniscus* Stål, 1875

1. In tegmina, beginning of radial vein and media parallel, than abruptly diverging .....
2. – In tegmina, radial vein and media evenly diverging .....
3. 2. Mesofemora with large lobe ventrally .....
- ..... *C. lobipes* Redtenbacher
- Mesofemora dorsally and ventrally evenly dilated .....
- ..... *C. lobiventris* (Blanchard)
3. Protibiae with lobes .....
4. – Protibiae without lobes .....
- ..... *C. feejeanus* (Westwood)



Fig. 6. *Phyllium (Pulchriphyllium) bioculatum* Gray, 1832, ♂.



Fig. 7. *Phyllium (Pulchriphyllium) bioculatum* Gray, 1832, ♀.

4. Abdomen almost quadrate, lateral margins parallel ..... *C. erosus* Redtenbacher  
 – Abdomen distinctly longer than wide .....  
 ..... *C. brachysoma* (Sharp)

### *Microphyllium* Zompro, 2001

*Microphyllium* Zompro, 2001e: 52; Größer 2001: 48.

**Type-species.** *Microphyllium spinithorax* Zompro, 2001, by original designation.

**Distribution.** Philippines.

**Diagnosis.** Smallest Phylliini, males less than 25 mm long. Visible part of mesothorax in front of tegmina transverse. Prosternum swollen in the anterior half. Profemora without distinct appendices dorsally. Lateral margins of abdomen of male parallel.

**Species included.** *Microphyllium spinithorax* Zompro, 2001: 52, fig. 7-12.

**Material examined.** *Microphyllium spinithorax* Zompro, 2001: HT, ♂; PT, 1♀ n5, 1♀ n4, Luzon, St. Thomas. [SMTD].

**Comments.** Adult females and eggs are not known in this genus.

### *Phyllium* Illiger, 1798

*Phyllium* Illiger, 1798: 499; Westwood 1859: 171; Kirby 1890: 574; Kirby 1904: 422; Redtenbacher 1906: 172; Rehn & Rehn 1933: 411; Klante 1976: 49; Liu 1993: 201; Zompro 2001c: 151; Bragg 2001: 189; Größer 2001: 50.

= *Pteropus* Thunberg, 1815: 219, synonymized by Audinet-Serville, 1831: 63. Preoccupied by *Pteropus* Brisson, 1762 (Mammalia), and Erxleben, 1777 (Mammalia).

**Type-species.** *Phyllium* Illiger, 1798: *Gryllus* (*Mantis*) *siccifolius* Linnaeus, 1758: 425, by monotypy.

*Pteropus* Thunberg, 1815: *Gryllus* (*Mantis*) *siccifolius* Linnaeus, 1758: 425, by monotypy.

**Distribution.** Tropical South-East-Asia.

**Diagnosis.** Medium to large Phylliini. Anal region of alae transparent. Mesonotum in front of tegmina about quadrate, not strikingly transverse.

**Comments.** This genus contains the famous phasmids which have been reared by enthusiasts and in zoos for more than a century now.

### *Phyllium* (*Phyllium*) Illiger, 1798

**Type-species.** *Gryllus* (*Mantis*) *siccifolius* Linnaeus, 1758: 425, by monotypy.

**Distribution.** Tropical South-East-Asia.

**Diagnosis.** Members of this subgenus are characterized by the absence of interior lobes on the prothorax.

**Species included.** *Phyllium athanyus* Westwood, 1859: 174, pl. 31: 3; *Phyllium bilobatum* Gray, 1843: 120; *Phyllium brevipennis* Gröber, 1992: 164, fig. 1; *Phyllium caudatum* Redtenbacher, 1906: 177; *Phasma* (*Phyllium*) *celebicum* de Haan, 1842: 111; *Phyllium chitoniscoides* Gröber, 1992: 165, fig. 2, 3a-c; *Phyllium elegans* Gröber, 1991: 279, fig. 1, 2a-d; *Phyllium frondosum* Redtenbacher, 1906: 175 = *Phyllium insulanicum* Werner, 1922: 126, synonymized by Klante, 1976: 61; *Phyllium geryon* Gray, 1843: 118, fig. a; *Phyllium hausleithneri* Brock, 1999: 165, fig. 111; *Phyllium jacobsoni* Rehn & Rehn, 1934: 419, pl. 17: 7; *Phyllium keyicum* Karny, 1914: 7, fig. 5; *Phyllium* (*Phyllium*) *palawanensis* Gröber, 2001: 86, fig. 113-114a-c; *Phyllium parum* Liu, 1993: 207, fig. 15-16; *Phyllium pusillulum* Rehn & Rehn, 1934: 417, pl. 17: 8; *Phyllium rarum* Liu, 1993: 207, fig. 13-14; *Gryllus* (*Mantis*) *siccifolius* Linnaeus, 1758: 425 = *Mantis foliatus* Perry, 1810: 81, synonymized by Redtenbacher, 1906: 176 = *Phasma chlorophyllia* Stoll, 1813: 69, pl. 22: 89, synonymized by de Haan, 1842: 111 = *Phasma citrifolium* Lichtenstein, 1796: 78, synonymized by Gray, 1835: 30 = *Phyllium stollii* Le Peletier de St. Fargeau & Audinet-Serville, 1825: 115, synonymized by Gray, 1835: 31 = *Phyllium brevicorne* Latreille, 1807: 89, replacement name for *Phyllium siccifolium* (Linnaeus) from Moluccas, synonymized by Gray, 1835: 30 = *Phyllium donovani* Gray, 1835: 31, synonymized by Redtenbacher, 1906: 176 = *Phyllium gorgon* Gray, 1835: 31, synonymized by Redtenbacher, 1906: 176; *Phyllium westwoodi* Wood-Mason, 1875: 215, pl. 16, 17; *Phyllium woodi* Rehn & Rehn, 1934:

423, pl. 16: 3, 17: 6; *Phyllium yunnanense* Liu, 1993: 210, fig. 17-18; *Phyllium* (*Phyllium*) *zomproi* Gröber, 2001: 101, fig. 22, 129-130a-c, 131-132.

**Material examined.** *P. (Ph.) brevipennis* Gröber, 1992: HT, ♀, Komba-Distr. Finisterre Geb. D. Neu-Guinea; ded. Nagel Mai 1930; *Phyllium brevipennis* Gröber 22.2.1992 [DEIC].

*P. (Ph.) caudatum* Redtenbacher, 1906: 1♂, Papua Neuguinea, Aseki, 8.1998 [DEICDG].

*P. (Ph.) chitoniscoides* Gröber, 1992: HT, ♀, Bolan Gbg N. Guinea; Bolan Gbg N. Guinea; Staudinger; *Phyllium chitoniscoides* Grö. det. Gröber 22.2.1992 [DEIC]; PT, 1W, Pama Maga [DEICDG].

*P. (Ph.) elegans* Gröber, 1991: HT, ♀, 12 eggs ex abdomen: Deutsch-Neu-Guinea, Hahl coll.; Typus det. Gröber 2.10.1990. [ZSMC].

*P. (Ph.) frondosum* Redtenbacher, 1906: HT, ♂, Neu-Guinea Fr. Wiengreen ded. 1.XI.1894.; *Phyllium frondosum* Redt. ♀ Typus. Jos. Redtenbacher determ. 1899 public. 1906-08. Bestimm.-Verz. Nr. 435. [ZMH]; 1♀n5: Satelberg, N. Guin.; 832 [ZMUK].

*P. (Ph.) palawanensis* Gröber, 2001: HT, ♀, Philippines, Palawan Id, Port Barton, Roaxas, Matalangso, 200-350 m [DEICDG]; PT, 1♀, Philippines, Palawan Id, Port Barton, Roaxas, Matalangso, 200-350 m, 16.V.1985, leg. R. A. Müller.; 452-1 Coll. O. Zompro [ZMUKOZ].

*P. (Ph.) siccifolium* (Linnaeus, 1758): 1♂, Penang Ins., 3.1993 [DEICDG]; 1♀, no data [ZMUKOZ].

*Phyllium* (*Phyllium*) *zomproi* Gröber, 2001: HT, ♀, Neu Guinea, Wingia, Aseki. PT: 1♂ nymph, stage 4: Wingia; 2♀, Neu Guinea, Wingia, Aseki; 1 ♀, Kanabea [DEICDG].

### *Phyllium* (*Pulchriphyllium*) (Griffini, 1898)

*Pulchriphyllium*: Kirby, 1904: 421; Giglio-Tos 1912: 56.

*Phyllium* (*Pulchriphyllium*): Griffini 1898a: 2; 1898b: 11; Redtenbacher 1906: 173; Klante 1976: 49; Bragg 2001: 189.

**Type-species.** *Phyllium pulchrifolium* Audinet-Serville, 1838: 292, by subsequent designation of Griffini, 1898b: 11.

**Distribution.** Tropical South-East-Asia.

**Diagnosis.** Differing from the subgenus *Phyllium* by the presence of interior lobes on the profemora.

**Species included.** *Phyllium* (*Pulchriphyllium*) *asekiensis* Gröber, 2002: 2, fig. 1-3; *Phyllium bioculatum* Gray, 1832: 191, pl. 63: 3 = *Phyllium agathyrus* Gray, 1843: 122, fig. h, synonymized with *P. pulchrifolium* Audinet-Serville, 1838, by Redtenbacher, 1906: 175. Synonymy doubted by Rehn & Rehn, 1933: 412, referring in error to Westwood as author. = *Phyllium crurifolium* Audinet-Serville, 1838: 291, synonymized by Bolívar, 1895: 374 = *Phyllium dardanus* Westwood, 1859: 176, pl. 40: 5, synonymized by Redtenbacher,





Fig. 8. *Phyllium siccifolium* (Linnaeus, 1758), ♂.



Fig. 9. *Phyllium siccifolium* (Linnaeus, 1758), ♀.

1906: 175 = *Phyllium gelonus* Gray, 1843: 121, synonymized by Griffini, 1898: 4 = *Phyllium magdelainae* Lucas, 1857: 147, synonymized by Klante, 1976: 55 = *Phyllium pulchrifolium* Audinet-Serville, 1838: 292, synonymized by Brock, 1999: 191 = *Phyllium scythe* Gray, 1843: 122, synonymized by Redtenbacher, 1906: 175; *Phyllium drunganum* Yang, 1995: 18, figs. 1-3; *Phyllium (Pulchriphyllium) exsectum* Zompro, 2001f: 73, fig. 95-96; *Phyllium giganteum* Hausleithner, 1984: 39, fig. 1-3; *Phyllium groesseri* Zompro, 1998: 159 fig. 6-8; *Pulchriphyllium schultzei* Giglio-Tos, 1912: 56; *Phyllium (Pulchriphyllium) sinensis* Liu, 1990: 227, fig. 1-2; *Phyllium (Phyllium) tibetense* Liu, 1993: 203, fig. 3-5.

**Material examined.** *P. (Pu.) asekiensis* Größer, 2002: HT, ♀, Neuguinea, Mt. Aseki, X. 2000 [DEICDG].

*P. (Pu.) bioculatum* Gray, 1832: HT, ♂, no data [OXUM] 1♂, Dambulla 400-600 m. Ceylon [ZMUK]; 1♀, Ostindien, Gruber [ZMUK].

*P. (Pu.) exsectum* Zompro, 2001: HT, ♀, Rawlinson Mts.; Rawlinson Mts., inland Huon Gulf. (Keysser); Rothschild Bequest B. M. 1939-1. [BMNH].

*P. (Pu.) giganteum* Hausleithner, 1984: 1♂, reared by D. Größer [DEICDG]; 1♀, reared by O. Zompro [ZMUKOZ].

*P. (Pu.) groesseri* Zompro, 1998: HT, ♀, Buin, I. Bougainville, Arch. Salomons. [SMTD]; PT, 1♂, Salomon Islands, Konga Village, Buin Area, Bougainville, 21.III. 1961. [ANIC].

*P. (Pu.) schultzei* (Giglio-Tos, 1912): HT, ♀, Neu Guinea (No. 131), VIII.1910. L. Schultze S. G.; Mossee, südl.

von Germaniahuk; *Pulchriphyllium schultzei* Gigl.-Tos E. Giglio-Tos, det. [DEIC]; 1♂, Papua Neuguinea, Dez.1990 [DEICDG].

#### Preliminary key to males of *Phyllium* Illiger, 1798

1. Protibiae with exterior lobes only ..... 2. *P. (Phyllium)* Illiger
- Protibiae with interior and exterior lobes ..... 11. *P. (Pulchriphyllium)* Griffini
2. Anterior half of prosternum with a tubercle .... *P. (P.) caudatum* Redtenbacher
- Anterior half of prosternum without tubercle . ..... 3.
3. Mesonotum trapezoid ..... 4.
- Anterior part of mesonotum strikingly narrow, sides parallel ..... 9.
4. Profemora without exterior lobe ..... 5.
- Profemora with distinct exterior lobe ..... 7.
5. Abdomen rhombic ..... *P. (P.) geryon* Gray
- Abdomen more rounded laterally ..... 6.
6. Visible part of mesonotum at best as long as pronotum ..... *P. (P.) jacobsoni* Rehn & Rehn

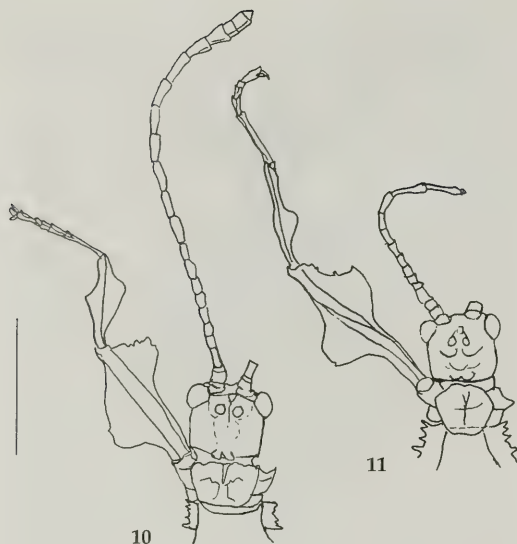


Fig. 10. Head and prothorax of *Nanophyllium pygmaeum* Redtenbacher, 1906, ♂, HT.

Fig. 11. Head and prothorax of *Nanophyllium adisi*, spec. nov., ♂, HT.

- Visible part of mesonotum longer than pronotum ..... *P. (P.) woodi* Rehn & Rehn
- 7. Abdominal segment IV widest segment ..... 8.
- Abdominal segment V widest segment .....  
..... *P. (P.) parum* Liu
- 8. Abdominal segments V to X evenly decreasing in width ..... *P. (P.) yunnanense* Liu
- Abdominal segment IX anteriorly abruptly narrowed ..... *P. (P.) zomproi* Gröbner
- 9. Profemora without exterior lobe .....  
..... *P. (P.) siccifolium* (Linnaeus)
- Profemora with exterior lobe ..... 10.
- 10. Profemora straight .....  
..... *P. (P.) celebicum* (de Haan)
- Profemora curved .....  
..... *P. (P.) westwoodi* Wood-Mason
- 11. Profemora without exterior lobe .....  
..... *P. (Pu.) schultzei* (Giglio-Tos)
- Profemora with exterior lobe ..... 12.
- 12. Exterior lobe of metafemora rounded .....  
..... *P. (Pu.) bioculatum* Gray
- Exterior lobe of metafemora triangular, pointed .....  
..... *P. (Pu.) giganteum* Hausleithner

### Preliminary key to females of *Phyllium* Illiger, 1798

1. Protibiae with exterior lobes only .....  
..... 2. *P. (Phyllium)* Illiger
- Protibiae with interior and exterior lobes .....  
..... 22. *P. (Pulchriphyllium)* Griffini
2. Anterior half of prosternum with a tubercle ....  
..... *P. (P.) caudatum* Redtenbacher
- Anterior half of prosternum without tubercle .  
..... 3.
4. Mesonotum trapezoid ..... 5.
- Anterior part of mesonotum strikingly narrow,  
sides parallel ..... 17.
5. Tegmina not projecting beyond abdominal seg-  
ment II ..... *P. (P.) brevipennis* Gröbner
- Tegmina longer ..... 6.
6. Abdominal segment VIII abruptly narrowed 7.
- Abdominal segment VII posteriorly about as  
wide as VIII anteriorly ..... 14.
7. Abdominal segment VII with posterolateral lobes  
..... 8.
- Abdominal segment VII without posterolateral  
lobes ..... 9.
8. Abdomen considerably longer than wide .....  
..... *P. (P.) bilobatum* Gray
- Abdomen about as wide as long .....  
..... *P. (P.) chitoniscoides* Gröbner
9. Tegmina projecting beyond abdominal segment  
VI ..... 10.
- Tegmina shorter ..... 12.
10. Exterior lobe of profemora more than twice as  
wide as interior one .....  
..... *P. (P.) celebicum* (de Haan)
- Exterior lobe of profemora as wide as interior  
one ..... 11.
11. Meso- and metafemora distinctly serrated ven-  
trally ..... *P. (P.) jacobsoni* Rehn & Rehn
- Meso- and metafemora almost smooth ventrally  
..... *P. (P.) elegans* Gröbner
12. Exterior lobe of profemora wider than interior  
one ..... 13.
- Interior lobe of profemora wider than exterior  
one ..... *P. (P.) pusillulum* Rehn & Rehn
13. Exterior lobe of profemora distinctly serrated .  
..... *P. (P.) frondosum* Redtenbacher



Fig. 12. Eggs of Phylliidae: 1. *P. (P.) siccifolium* (Linnaeus, 1758). 2. *P. (P.) caudatum* Redtenbacher, 1906. 3. *P. (P.) celebicum* de Haan, 1842. 4. *P. (P.) keyicum* Karny, 1914. 5. *P. (P.) geryon* Gray, 1834. 6. *P. (P.)* sp. Philippines. 7-9. *P. (Pu.) biculatum* Gray, 1832, variations. 10. *P. (Pu.) giganteum* Hausleithner, 1984. 11. *P. (Pu.) bilobatum* Gray, 1843. 12. *P. (Pu.) elegans* Gröber, 1991.

- Exterior lobe of profemora smooth ..... 20. Pars stridens of third antennomere with 58-60 teeth ..... *P. (P.) siccifolium* (Linnaeus)
- ..... *P. (P.) keyicum* Karny
- Pars stridens of third antennomere with 40 teeth
- ..... *P. (P.) palawanensis* Gröber
- 14. Tegmina projecting beyond abdominal segment VII ..... 15.
- Tegmina not projecting beyond abdominal segment VII ..... 16.
- 15. Abdominal segments V-IX evenly narrowed ...
- ..... *P. (P.) geryon* Gray
- Abdominal segments VIII abruptly narrowed posteriad ..... *P. (P.) zomproi* Gröber
- 16. Exterior lobe of profemora wide, roundly triangular ..... *P. (P.) rarum* Liu
- Exterior lobe of profemora narrow, evenly rounded ..... *P. (P.) woodi* Rehn & Rehn
- 17. Exterior lobe of profemora about as wide as interior one ..... 18.
- Exterior lobe of profemora distinctly wider than exterior one ..... 21.
- 18. Lateral margins of abdominal segment VIII about parallel ..... *P. (P.) hausleithneri* Brock
- Lateral margins of abdominal segment VIII diagonal ..... 19.
- 19. Alae fully developed ..... *P. (P.) westwoodi* Wood-Mason
- Alae rudimentary or completely reduced ... 20.
- 20. Pars stridens of third antennomere with 58-60 teeth ..... *P. (P.) siccifolium* (Linnaeus)
- Pars stridens of third antennomere with 40 teeth
- ..... *P. (P.) palawanensis* Gröber
- 21. Lateral margin of abdomen evenly narrowed posteriad ..... *P. (P.) athanyus* Westwood
- Lateral margin of abdomen abruptly narrowed after segment VII .... *P. (P.) celebicum* (de Haan)
- 22. Anterior half of prosternum with a tubercle ....
- ..... *P. (Pu.) aseekiensis* Gröber
- Anterior half of prosternum without tubercle .
- ..... 23.
- 23. Mesonotum trapezoid ..... 24.
- Anterior part of mesonotum strikingly narrow, sides parallel ..... 28.
- 24. Abdominal segment VI without large lobe . 25.
- Abdominal segment VI with large lobe posterolaterally ..... *P. (Pu.) exsectum* Zompro
- 25. Head about as wide as pronotum ..... 26.
- Head almost twice as wide as pronotum .....
- ..... *P. (Pu.) drunganum* Yang
- 26. Exterior lobe of profemora triangular, distinctly larger than interior one .... *P. (Pu.) tibetense* Liu
- Exterior lobe of profemora small, flat ..... 27.

27. Abdomen more oval .....  
 ..... *P. (Pu.) schultzei* (Giglio-Tos)  
 – Abdomen quadrate, about as long as wide .....  
 ..... *P. (Pu.) groesseri* Zompro
28. Genital valves almost reaching tip of abdomen  
 ..... *P. (Pu.) giganteum* Hausleithner  
 – Genital valves considerably shorter ..... 29.
29. Abdominal segments VIII-X evenly narrowed  
 ..... *P. (Pu.) bioculatum* Gray  
 – Abdominal segment VIII almost surrounding  
 IX and X ..... *P. (Pu.) sinensis* Liu

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**Note.** The name "Größer" is often cited as "Grösser" or "Groesser". In German language it is possible to replace "ö" by "oe" and "ß" by "ss". The correct spelling is "Größer".